Water Acquisition and Management Subcommittee
Position Paper: Evapotranspiration Water

Introduction:

- *Evapotranspiration (ET)* is the combined transfer to the atmosphere through *evaporation* of liquid water from water, soil, and other environmental surfaces plus the *transpiration* of liquid and gaseous water from plants.
- A basis for estimating and comparing evaporation water rates in the environment is daily measurements of evaporative water loss from a standard, "Class A" evaporation pan (metal pans having 4-foot diameters and vertical sides).
- Because of the relatively small diameter and shallow depths of evaporation pans, they tend to have higher evaporation rates than other environmental surfaces. In general, the magnitude of annual water loss from different surfaces occurs as follows: pan evaporation > open water > bare saturated soil > riparian vegetation > upland vegetation > dry soil. A ratio of approximately 0.7 exists between pan evaporation rates and evaporation rates from large water bodies like reservoirs; greater ratios can occur for evaporation from other environmental surfaces.

Basin Depletions and Riparian ET:

- Estimated total average annual ET water losses along the Rio Grande from Otowi to Elephant Butte (674,000 acre-feet per year, including groundwater uses). these basin depletions are disturbed distribute among crops (34 percent, 230,000 acre-feet per year), riparian plants (33 percent, 222,000 acre-feet per year), reservoir evaporation (19 percent, 128,000 acre-feet per year) and urban uses (14 percent, 94,000 acre-feet per year) (SSP&A 2000).
- The invasion by non-native saltcedar and Russian olive into the Rio Grande bosque, with resulting widespread dense expanses of these exotic phreatophytes, is generally viewed as having significantly increased the ET rate by the riparian community and basin depletion losses of water for the MRG. In turn, restoration of the native riparian plant community along the Rio Grande is generally forecasted as expected to produce measurable decreases in riparian ET, basin depletion rates, and increase flows in the river.
- Saltcedar stands are frequently reported to use more water per unit land area than native riparian species (Gatewood et al. 1950, Weeks et al. 1987, King and Bawazir 2000), but saltcedar transpiration rates have been found to be no greater than native riparian plants on a per unit leaf area basis (Sala et al. 1996). Apparently, the relatively greater water consumption potentials of saltcedar is based on their tendencies to produce very dense stands having very high total leaf areas.
- Greater groundwater depths increase the energetic requirements of transpiration and reduce potential transpiration rates (Weeks et al. 1987, Doorenbos et al. 1992). A significant difficulty in interpreting transpiration rates for native and non-native riparian plant species along the MRG is the lack of comparative measurements for both plant groups collected at equal groundwater depths.
- Saltcedar cleared from 21,500 acres of floodplain of the Pecos River between Acme and Artesia, NM was projected to increase baseflow in the river by 10,000 to 20,000 acre feet per year, but such flow gains were not subsequently observed in the stream-flow gage

records (Weeks et al. 1987). It was suggested that possible gains may have been masked by variations in climate, increased groundwater pumping, and/or increases in groundwater recharge rates. (It is also possible that potential ET benefits from removal of non-native communities were projected using incorrect, over optimistic estimators for potential ET reductions.)

Estimated Ranges for Environmental ET Rates along the MRG:

- Estimated ET values used at Los Lunas restoration site for seven environmental cover types (USACE and USBR 2002):

Environmental cover types	Low Estimate	High Estimate
	ET Value (feet/year)	
Open water	4.2	5.1
Saltcedar/Russian olive	4.2	4.9
Willow (no range available)	4.2	4.2
Sweet clover/sunflower (alfalfa/wheat)	3.0	5.9
Cottonwood	3.0	4.8
Wet sandbar (no range available)	1.75	1.75
Grassland	0.0	1.99

- Dahm et al. (2002) reported estimated ET at four MRG sites with distinctive vegetation characteristics:

Vegetation type	Annual (growing season) ET
Mature cottonwood with extensive saltcedar and Russian olive understory, without flooding (South Albuquerque valley)	123 cm/yr (4.0 ft/yr)
Mature, closed canopy cottonwood stand, with flooding (Belen)	98 cm/yr (3.2 ft/yr)
Dense salt cedar, with flooding (Bosque del Apache)	111-122 cm/yr (3.6 – 4.0 ft/yr)
Moderately dense saltcedar stand, rare flooding (Sevilleta)	74-76 cm/yr (ca. 2.5 ft/yr)

- Based on data from sites in the last two rows, Cleverly et al. (2002) concluded that ET rates were 61 percent lower in unflooded relative to flood saltcedar communities along the MRG.

WAM Conclusion and Recommendations on Potential Benefits from ET Water Savings:

1. Variations in measured ET values for non-native and native stands indicate that local differences in stand characteristics (e.g., leaf are densities), soils, ambient climate, depth to water table, and flooding complicate the extrapolation of ET data over time and space.
2. Accurate determinations of riparian depletions along the MRG also require site-specific characterization of soil, groundwater depth, topography, flooding characteristics, groundwater, and vegetation condition, with quantitative understanding of vegetation responses to variations in these physical characteristics.

3. The available data suggest that conversion of non-native to native riparian vegetation stands may not always result in reduced ET rates and reduced depletions. Available data indicate that after restoration of native riparian communities long-term increases may follow short-term reductions in ET, particularly if flood frequency is increased.
4. Activities such as island shaving and removal (i.e., the conversion from either native or non-native vegetated island communities to open water surfaces, likely to result when stabilizing vegetation is removed from islands) may result in initial short-term (e.g., 1-2 year) reductions in ET, followed by longer-term increases in ET losses and depletions.
5. Until ET relationships are better defined on a site-by-site basis, conservatively biased ET values may be used to estimate potential restoration related affects on ET.
6. The potential benefits in reducing ET based depletions along the MRG through the restoration of non-native to native riparian communities and restoration options should continue to be assessed.

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